

<p align="center">17 GUNSHOT RESIDUE</p>	<p align="center">Page 1 of 11</p>
<p align="center">Division of Forensic Science</p> <p align="center">TRACE EVIDENCE TRAINING MANUAL</p>	<p>Amendment Designator:</p>
	<p>Effective Date: 29-March-2004</p>
<p align="center">17 GUNSHOT RESIDUE</p> <p>17.1 Introduction to Formation, Collection and Analysis</p> <p>17.1.1 Objectives</p> <p>Through completion of this module the trainee will develop the theoretical knowledge to be conversant in:</p> <ul style="list-style-type: none"> • The theory of GSR formation; • Methods of GSR collection; • The history of GSR detection methods; and, • Bulk elemental analysis versus SEM/EDS analysis. <p>17.1.2 Required Readings</p> <p>An enormous amount of background reading is required, the majority of which should be done prior to discussions with the trainer.</p> <p>17.1.2.1 Aerospace Corporation, "Final Report on Particle Analysis for Gunshot Residue Detection" LEA, 1977.</p> <p>17.1.2.2 Basu, S., "Formation of Gunshot Residues," <i>Journal of Forensic Sciences</i>, Vol. 27, 1982, pp. 72-91.</p> <p>17.1.2.3 Basu, S. and Ferriss, S., "A Refined Collection Technique for Rapid Search of Gunshot Residue Particles in the SEM," <i>Scanning Electron Microscopy</i>, Vol 1, 1980, pp.375-384 and 392.</p> <p>17.1.2.4 Basu, S. Ferriss, S., and Horn, R., "Suicide Reconstruction by Glue-Lift of Gunshot Residue," <i>Journal of Forensic Sciences</i>, Vol. 29, 1984, pp. 843-864.</p> <p>17.1.2.5 Cowan, M. E. and Purdon, P. L., "A Study of the Paraffin Test" <i>Journal of Forensic Sciences</i>, Vol. 12, 1967, pp. 19-36.</p> <p>17.1.2.6 DeGaetano, D. H., Siegel, J. A., and Klomparens, K. L., "A Comparison of Three Techniques Developed for Sampling and Analysis of Gunshot Residue by Scanning Electron Microscopy and Energy Dispersive X-Ray Analysis," <i>Journal of Forensic Sciences</i>, Vol. 37, 1992, pp. 281-300.</p> <p>17.1.2.7 <u>F.B.I. Law Enforcement Bulletin</u>, 4, 5, "The Dermal Nitrate Test", 1935.</p> <p>17.1.2.8 Meng, H. H., and Caddy, B., "Gunshot Residue Analysis – A Review", <i>Journal of Forensic Sciences</i>, Vol. 42, 1997, pp. 553-570.</p> <p>17.1.2.9 Singer, R. L., et. al., "A Survey of Gunshot Residue Analysis Methods," <i>Journal of Forensic Sciences</i>, Vol. 41, 1996, pp. 195-198.</p> <p>17.1.2.10 Schwoeble, A. J. and Exline, D. <u>Current Methods in Forensic Gunshot Residue Analysis</u>, c. 2000.</p> <p>17.1.3 Questions</p> <p>The trainee will provide written answers to the following questions:</p> <ul style="list-style-type: none"> • Briefly describe the difference between GSR and primer residue. • What is the significance in morphology of GSR? • Describe various GSR collection techniques and their pros and cons. • Compare and contrast microchemical vs. elemental analysis. • Compare and contrast bulk elemental analysis vs. SEM/EDS analysis. 	

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<div> <ul style="list-style-type: none"> Describe the pitfalls in “suicide reconstruction by GSR analysis”. </div> <div> <p>17.1.4 Practical Exercises</p> <div> <p>17.1.4.1 The trainee will update the Trace Evidence Section’s bibliography of GSR publications.</p> </div> </div> <div> <p>17.1.5 Evaluation</p> <div> <p>17.1.5.1 The trainer will review the written answers to the questions with the trainee.</p> <p>17.1.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.</p> <p>17.1.5.3 Review of practical exercises.</p> <p>17.1.5.4 The trainee will be quizzed orally upon the subject matter.</p> </div> </div> <p>17.2 Ammunition</p> <div> <p>17.2.1 Objectives</p> <p>Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:</p> <ul style="list-style-type: none"> Describe ammunition components and their contributions in SEM/EDS analysis; Recognize differences between conventional primer composition and “lead free” primers; and, Understand how manufacturer, caliber and age of ammunition can affect the amount and type of GSR deposited on the hands of a shooter. </div> <div> <p>17.2.2 Required Readings</p> <div> <p>17.2.2.1 Bydal, B., “Percussion Primer Mixes,” <i>AFTE Journal</i>, Vol. 22, No. 1, January 1990.</p> <p>17.2.2.2 Harris, A., “Analysis of Primer Residue from CCI Blazer Lead Free Ammunition by Scanning Electron Microscopy/Energy Dispersive X-Ray,” <i>Journal of Forensic Sciences</i>, Vol. 40, No. 1, January 1995.</p> <p>17.2.2.3 Gunaratnam, L. and Kimmo Himberg, “The Identification of Gunshot Residue from Lead – Free Sintox Ammunition,” <i>Journal of Forensic Sciences</i>, Vol. 39, No. 2, March 1994.</p> <p>17.2.2.4 Midkiff, C. R., “The Changing Face of Firearms Residue Testing. Then and Now,” Parts 1, 2, 3 and 4; <i>MAAFS Newsletter</i>, Vol. 25, No. 2, 3, and 4, 1997 and Vol. 28, No. 3, 2000.</p> <p>17.2.2.5 Wallace, J. S. and McQuillan, J. “Discharge Residues from Cartridge-operated Industrial Tools,” <i>Journal of Forensic Science Society</i>, Vol. 24, 1984, pp 495-508.</p> <p>17.2.2.6 Wallace, J. S., “Chemical Aspects of Firearms Ammunition,” <i>AFTE Journal</i>, Vol. 22, No. 4, October 1990.</p> <p>17.2.2.7 Wallace, J.S. “Discharge Residue Particles from Blank Cartridges,” <i>AFTE Journal</i>, Vol. 21, No. 2, April 1989.</p> <p>17.2.2.8 Zeichner, Arie, et. al., “Antimony Enrichment on the Bullets’ Surfaces and the Possibility of Finding It in Gunshot Residue (GSR) of Ammunition Having Antimony-Free Primers,” <i>Journal of Forensic Science Society</i>, Vol. 43, No. 3, 1998.</p> </div> </div>	

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<p>17.2.2.9 Zeichner, A., et. al., "Gunshot Residue Particles Formed by Using Ammunitions That Have Mercury Fulminate Based Primers," <i>JFSCA</i>, Vol. 37, No. 4, Nov. 1992.</p> <p>17.2.2.10 Zeichner, A., et. al., "Gunshot Residue Particles Formed by Using Different Types of Ammunition in the Same Firearms," <i>JFSCA</i>, Vol. 36, No. 4, July 1991.</p> <p>17.2.2.11 Zeichner, A. and Levin, N., "More on the Uniqueness of Gunshot Residue (GSR) Particles," <i>Journal of Forensic Sciences</i>, Vol 42, No. 6, 1997.</p> <p>17.2.2.12 Zona, C. A., "The Analysis of Nyclad Ammunition Discharge Residues Using Transmission Electron Microscopy and Polarized Light Microscopy," <i>Microscope</i>, Vol. 44:1, 1996, pp. 11-14.</p> <p>17.2.3 Questions</p> <p>The trainee will provide written answers to the following questions:</p> <ul style="list-style-type: none"> • How do the elements encountered in components of ammunition, including the various types of primers compare to the list of "permissible" elements in GSR as suggested by the Aerospace Corp? • What differences might be expected between classic primer residue and residue from "roofing guns" or starting pistols? • Describe the difference between Boxer and Berdan primed ammunition and its corresponding GSR. • Describe typical chemical compounds used as oxidizers, fuels, sensitizers and frictionators in primer mixes. • What elements might be found in residue from "lead free" primers and why is this problematic for automated SEM/EDS analysis? • What is the most common type of primer residue produced by .22 cal ammunition? • What is the danger of using "headstamp" information to draw conclusions about primer residue composition? • What is Co in GSR a potential indicator of? <p>17.2.4 Practical Exercises</p> <p>17.2.4.1 The trainer will arrange for the trainee to work in conjunction with a Firearms examiner to complete the following :</p> <p>17.2.4.1.1 Test fire the following cartridges and determine the elemental composition in the primer cup area of the cartridge case. Use a wooden applicator stick to scrape the appropriate area of the case and touch the end of the stick to a prepared SEM stub. Also sample the hand of the shooter after each firing. Use a revolver for the .22, a semi auto for the 9mm and a revolver for the .38. Clean the weapon between each firing and wash the hand between each firing.</p> <ul style="list-style-type: none"> • Federal .22 LR power-flite with lead bullet • Remington .22 LR yellow jacket • CCI Blazer .22 LR with lead bullet • W-W .22 LR with copper wash bullet • 9mm Luger W-W with 115 gr. FMJ bullet • 9mm Luger Wolf with 115 gr. FMJ bullet • 9mm Luger Winchester Ranger with a 85 gr Frangible bullet • 9mm Luger PMC with a 124 gr FMJ bullet • .38 Spl. CCI Speer with a 110 gr. Jacketed HP • .38 Spl. CCI Blazer with 158 gr RN bullet • .38 Spl. PMC with a 158 gr. Lead RN bullet • .38 Spl. Remington Golden Saber 	

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<div data-bbox="440 260 1542 415"> <p>17.2.4.1.2 Test fire the following cartridges and determine the elemental composition in the primer cup area of the cartridge case. Use a wooden applicator stick to scrape the appropriate area of the case and touch the end of the stick to a prepared SEM stub. Also sample the hand of the shooter after each firing. Use a semi auto except for the .38 spl. Clean the weapon between each firing and wash the hand between each firing. Retain the samples for future analysis.</p> </div> <div data-bbox="581 447 998 604"> <ul style="list-style-type: none"> • Winclean .38 spl • Remington Leadless 9mm • Winchester Ranger frangible 9mm • Federal Balisticlean .40 • CCI Blazer lead free .45 </div> <div data-bbox="209 636 457 667"> <p>17.2.5 Evaluation</p> </div> <div data-bbox="342 699 1247 730"> <p>17.2.5.1 The trainer will review the written answers to the questions with the trainee.</p> </div> <div data-bbox="342 762 1536 793"> <p>17.2.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.</p> </div> <div data-bbox="342 825 756 856"> <p>17.2.5.3 Review of practical exercises.</p> </div> <div data-bbox="151 888 453 919"> <p>17.3 Collection of GSR</p> </div> <div data-bbox="248 951 457 982"> <p>17.3.1 Objectives</p> </div> <div data-bbox="342 1014 1497 1066"> <p>Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:</p> </div> <div data-bbox="391 1098 1140 1192"> <ul style="list-style-type: none"> • Instruct law enforcement officers in the proper collection of GSR; • Understand the limitations of sampling various surfaces; and, • Discuss sampling location issues with regard to suicide cases. </div> <div data-bbox="248 1224 545 1255"> <p>17.3.2 Required Readings</p> </div> <div data-bbox="342 1287 1523 1350"> <p>17.3.2.1 Schwartz, Robert H. and Charles Zona, "A Recovery Method for Airborne Gunshot Residue Retained in Human Nasal Mucus," <i>Journal of Forensic Sciences</i>, Vol. 40, No. 4. 1995.</p> </div> <div data-bbox="342 1381 1523 1444"> <p>17.3.2.2 Stone, I. C. and Petty, C. S., "Examination of Gunshot Residues," <i>Journal of Forensic Sciences</i>, Vol. 19, No. 4. 1974.</p> </div> <div data-bbox="342 1476 1523 1560"> <p>17.3.2.3 Wrobel, Harald, et. al., "Comparison of Properties of Adhesive Tapes, Tabs, and Liquids Used for the Collection of Gunshot Residue and Other Trace Materials for SEM Analysis <i>Journal of Forensic Sciences</i>, Vol. 43, No. 1, 1998.</p> </div> <div data-bbox="342 1591 1523 1654"> <p>17.3.2.4 Zeichner, A. and Levin, N., "Collection Efficiency of Gunshot Residue (GSR) Particles from Hair and Hands Using Double-Side Adhesive Tape," <i>Journal of Forensic Sciences</i>, Vol. 38, No. 3, 1993.</p> </div> <div data-bbox="248 1686 449 1717"> <p>17.3.3 Questions</p> </div> <div data-bbox="342 1749 1063 1780"> <p>The trainee will provide written answers to the following questions:</p> </div> <div data-bbox="391 1812 1513 1938"> <ul style="list-style-type: none"> • Who prepares GSR kits for DFS and how are they QC'd? • Why is clothing not typically sampled for GSR analysis by SEM/EDS and what are the exceptions to this general rule? • If a vehicle is sampled where are the best places to find GSR? </div>	

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<div data-bbox="391 264 1451 359"> <ul style="list-style-type: none"> • Which is a better place for collection of GSR in a suicide, at the scene or at the morgue? • How can blood on the hands affect GSR collection? • Under what circumstances would test firing a weapon in an alleged suicide case be considered? </div> <div data-bbox="207 390 545 420"> <p>17.3.4 Practical Exercises</p> </div> <div data-bbox="342 451 1446 480"> <p>17.3.4.1 Explain to the trainer how to properly use a GSR kit to include filling out all of the paperwork.</p> </div> <div data-bbox="207 512 459 541"> <p>17.3.5 Evaluation</p> </div> <div data-bbox="342 573 1247 602"> <p>17.3.5.1 The trainer will review the written answers to the questions with the trainee.</p> </div> <div data-bbox="342 634 1536 663"> <p>17.3.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.</p> </div> <div data-bbox="342 695 756 724"> <p>17.3.5.3 Review of practical exercises.</p> </div> <div data-bbox="151 756 435 785"> <p>17.4 Analysis of GSR</p> </div> <div data-bbox="245 816 456 846"> <p>17.4.1 Objectives</p> </div> <div data-bbox="342 877 1495 938"> <p>Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:</p> </div> <div data-bbox="391 970 1258 1131"> <ul style="list-style-type: none"> • Determine if a GSR sample requires carbon coating; • Conduct automated SEM/EDS analysis of GSR particles; • Understand the potential X-ray overlaps with regard to GSR; • Classify particles as being identified as or indicative of GSR; and, • Explain all QA/QC, negative and positive controls involved in GSR analysis. </div> <div data-bbox="245 1163 547 1192"> <p>17.4.2 Required Readings</p> </div> <div data-bbox="342 1224 1459 1285"> <p>17.4.2.1 Andrasko, J. and A.C. Maehly, "Detection of Gunshot Residue on Hands by Scanning Electron Microscopy," <i>Journal of Forensic Sciences</i>, Vol. 22, No. 4, 1977.</p> </div> <div data-bbox="342 1316 1476 1407"> <p>17.4.2.2 Kee, T. G. and C. Beck, "Casework Assessment of an Automated Scanning Electron Microscope/Microanalysis System for the Detection of Firearms Discharge Particles," <i>Journal of Forensic Science Society</i>, Vol. 27, 1987, pp. 321-330.</p> </div> <div data-bbox="342 1438 1495 1499"> <p>17.4.2.3 Lebedzik, Jozef and David Johnson, "Rapid Search and quantitative Analysis of Gunshot Residue Particles in SEM," <i>Journal of Forensic Sciences</i>, Vol. 45, No. 1, p. 83, 1999.</p> </div> <div data-bbox="342 1530 876 1560"> <p>17.4.2.4 Operators manual for Carbon evaporator.</p> </div> <div data-bbox="245 1591 449 1621"> <p>17.4.3 Questions</p> </div> <div data-bbox="342 1652 1065 1682"> <p>The trainee will provide written answers to the following questions:</p> </div> <div data-bbox="391 1713 1536 1904"> <ul style="list-style-type: none"> • What is "charging" and how can it be avoided? • Why is the negative control placed into the microscope before the samples to be analyzed? • If the same field is being analyzed on the positive control sample why can the number of GSR particles detected potentially change during the run? • Describe the steps to be taken if a GSR particle was found on a negative control sample. • What is the significance of large amounts of sulfur detected in a potential GSR particle? </div>	

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<p>17.4.4 Practical Exercises</p> <p>17.4.4.1 The trainer will discuss with the trainee how to take appropriate notes, how to properly use worksheets and what abbreviations are in standard use for GSR analysis.</p> <p>17.4.4.2 The trainee will conduct automated GSR analysis on the hand samples from the “lead free” ammunition collected and retained from 17.2.4.1.2.</p> <p>17.4.5 Evaluation</p> <p>17.4.5.1 The trainer will review the written answers to the questions with the trainee.</p> <p>17.4.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.</p> <p>17.4.5.3 Review of practical exercises.</p> <p>17.5 Retention of GSR</p> <p>17.5.1 Objectives</p> <p>Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:</p> <ul style="list-style-type: none"> • Discuss how long GSR would be expected to be found on the hands of a shooter; and, • Describe the methods of GSR deposition on the hands and how this material can be lost including environmental factors. <p>17.5.2 Required Readings</p> <p>17.5.2.1 Kilty, J.W., “Activity after Shooting and its Effect on the Retention of Primer Residue,” <i>Journal of Forensic Sciences</i>, Vol. 20, No. 2, 1975.</p> <p>17.5.2.2 Jalanti, T., Henchoz, P., Gallusser, A., Bonfanti, M. S. and Schwoeble, A. J. “The persistence of Gunshot Residue on Shooters’ Hands,” <i>Science & Justice</i>, Vol. 39, No. 1 1999.</p> <p>17.5.2.3 Mann, M. and Espinoza, E. O., “The Incidence of Transient Particulate Gunshot Residue in Oregon and Washington Bow Hunters,” <i>Journal of Forensic Sciences</i>, Vol. 38, No. 1, 1993.</p> <p>17.5.2.4 Reed, G. E., McGuire, P. J. and Boehm, A., “Analysis of Gunshot Residue Test Results in 112 Suicides,” <i>Journal of Forensic Sciences</i>, Vol. 35, No. 1, 1990.</p> <p>17.5.3 Questions</p> <p>The trainee will provide written answers to the following questions:</p> <ul style="list-style-type: none"> • How many particles does it take to determine whether a person fired, touched or was in close proximity to the discharge of a weapon? • Can it be determined whether someone fired a weapon with the right hand or left hand by GSR results? • What size GSR particle would be expected to be found in the air after a weapon is discharged and what significance does this have with regard to GSR in suicide cases? • How long does GSR remain on clothing? <p>17.5.4 Practical Exercises</p>	

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<p>17.5.4.1 The trainer will arrange for the trainee to work in conjunction with a Firearms examiner to test fire a .38 special revolver using PMC with a 158 gr. Lead RN bullet for all of the following exercises. The weapon will be cleaned and hands will be washed before each exercise. Each recovered sample will be analyzed with respect to amount and type of residue found and the trainee will plot the number of particles versus time.</p> <p>17.5.4.1.1 Fire one shot and collect one sample from the back of the shooting hand and one sample from the back of the non shooting hand immediately after the shooting.</p> <p>17.5.4.1.2 Fire one shot and collect one sample from the back of the shooting hand and one sample from the back of the non shooting hand 1 hour later after normal clerical activity.</p> <p>17.5.4.1.3 Fire one shot and collect one sample from the back of the shooting hand and one sample from the back of the non shooting hand 3 hours later after normal clerical activity.</p> <p>17.5.4.1.4 Fire one shot and collect one sample from the back of the shooting hand and one sample from the back of the non shooting hand 6 hours later after normal clerical activity.</p> <p>17.5.5 Evaluation</p> <p>17.5.5.1 The trainer will review the written answers to the questions with the trainee.</p> <p>17.5.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.</p> <p>17.5.5.3 Review of practical exercises.</p> <p>17.6 Interpretation of GSR</p> <p>17.6.1 Objectives</p> <p>Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:</p> <ul style="list-style-type: none"> List potential sources of indicative particles. <p>17.6.2 Required Readings</p> <p>17.6.2.1 Mosher, P.V., et. al., "Gunshot Residue – Similar Particles Produced by Fireworks," Can Soc. Forens. Sci. J., Vol. 31, No.2, 1998.</p> <p>17.6.2.2 Wolten, G. M., et. al., "Particle Analysis for the Detection of Gunshot Residue II: Occupational and Environmental Particles," <i>Journal of Forensic Sciences</i>, 1979.</p> <p>17.6.3 Questions</p> <p>The trainee will provide written answers to the following questions:</p> <ul style="list-style-type: none"> Where do spherical particles containing Ce and La come from? How is brake dust typically distinguished from GSR? What elements are expected in fireworks residue? Where might Sr residue be found and why is it significant? What elements are expected in a child's "cap" pistol <p>17.6.4 Practical Exercises</p>	

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<p>17.6.4.1 The trainee will collect 28 samples of brake dust from vehicles in our parking lot. Record the make, model and year of the vehicle and whether the dust is from a disc or drum brake. The trainee will analyze these samples by automated GSR analysis and will record particles that have the potential to be problematic.</p> <p>17.6.4.2 The trainee will collect 14 samples of fireworks residue. The trainee will analyze these samples by automated GSR analysis and will record particles that have the potential to be problematic.</p> <p>17.6.5 Evaluation</p> <p>17.6.5.1 The trainer will review the written answers to the questions with the trainee.</p> <p>17.6.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.</p> <p>17.6.5.3 Review of practical exercises.</p> <p>17.7 Supervised Casework</p> <p>The trainee will work at least thirty forensic cases as a technician for a qualified gunshot residue examiner. The trainer should ensure as much variety in the casework as is practicable.</p> <p>17.8 Report Writing</p> <p>The trainer will review and discuss with the trainee the standard report wording in Section 10.7 of the Trace Evidence Standard Operating Procedures.</p> <p>The trainer will provide ten cases previously examined by other qualified GSR examiners for the trainee to review and discuss with the trainer.</p> <p>The trainee will draft report wording as a part of the analysis of their training sets as well as when performing supervised casework.</p> <p>Report writing will be evaluated throughout the training period by the trainer.</p> <p>17.9 GSR Technical Presentation and Oral Examination</p> <p>The trainee will prepare a presentation of approximately 20-30 minutes in length which they will present to a group consisting of qualified GSR examiners, the QA Coordinator, as available, and any Director that chooses to attend. The presentation may cover either: the general theory and application of the instrumentation used in GSR analysis; the forensic examination of GSR; or a current topic that has been approved by the Section Chief that is of interest to the forensic GSR community.</p> <p>The trainee will field questions regarding their presentation topic as well as questions related to any/all aspects of their GSR training.</p> <p>17.10 Competency Evaluation and Mock Trial</p> <p>17.10.1 As the trainee progresses through GSR training, they will begin to process training sets as they would for casework to include drafting a Certificate of Analysis. There will be a minimum of three of these “case” files completed prior to issuance of the final competency test.</p> <p>17.10.2 Using one or all of the “cases” from 17.10.1, the trainee will undergo a series of “mini-mock trial” practice sessions with qualified examiners from the Trace Evidence Section. It may be useful to include practice sessions with examiners from Sections other than Trace Evidence.</p>	

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<p>17.10.3 The trainee will be provided with a final competency test for analysis. This test will mimic actual casework to the maximum extent possible and will include samples with at least one identified particle, one indicative particle, as possible, and a sample that is negative.</p> <p>The trainee will analyze the final competency test samples and issue a Certificate of Analysis based upon their findings. The trainee will be called upon to defend their results via testimony in a formal mock trial setting. The mock trial will typically be scheduled about two weeks after the GSR presentation and oral examination.</p> <p>17.10.4 The trainer and the trainee will review the mock trial video tape in a timely fashion.</p> <p>17.11 Certification</p> <p>Upon successful completion of the training process, following Section 15.6 of the Division of Forensic Science, Quality Manual, the trainee will be issued a written certification memorandum.</p> <p>17.12 Reading List</p> <p>17.12.1 Aerospace Corporation, "Final Report on Particle Analysis for Gunshot Residue Detection" LEA, 1977.</p> <p>17.12.2 Andrasko, J. and A.C. Maehly, "Detection of Gunshot Residue on Hands by Scanning Electron Microscopy," <i>Journal of Forensic Sciences</i>, Vol. 22, No. 4, 1977.</p> <p>17.12.3 Basu, S., "Formation of Gunshot Residues," <i>Journal of Forensic Sciences</i>, Vol. 27, 1982, pp. 72-91.</p> <p>17.12.4 Basu, S. and Ferriss, S., "A Refined Collection Technique for Rapid Search of Gunshot Residue Particles in the SEM," <i>Scanning Electron Microscopy</i>, Vol 1, 1980, pp.375-384 and 392.</p> <p>17.12.5 Basu, S. Ferriss, S., and Horn, R., "Suicide Reconstruction by Glue-Lift of Gunshot Residue," <i>Journal of Forensic Sciences</i>, Vol. 29, 1984, pp. 843-864.</p> <p>17.12.6 Bydal, B., "Percussion Primer Mixes," <i>AFTE Journal</i>, Vol. 22, No. 1, January 1990.</p> <p>17.12.7 Cowan, M. E. and Purdon, P. L., "A Study of the Paraffin Test" <i>Journal of Forensic Sciences</i>, Vol. 12, 1967, pp. 19-36.</p> <p>17.12.8 DeGaetano, D. H., Siegel, J. A., and Klomprens, K. L., "A Comparison of Three Techniques Developed for Sampling and Analysis of Gunshot Residue by Scanning Electron Microscopy and Energy Dispersive X-Ray Analysis," <i>Journal of Forensic Sciences</i>, Vol. 37, 1992, pp. 281-300.</p> <p>17.12.9 <u>F.B.I. Law Enforcement Bulletin</u>, 4, 5, "The Dermal Nitrate Test", 1935.</p> <p>17.12.10 Gunaratnam, L. and Kimmo Himberg, "The Identification of Gunshot Residue from Lead – Free Sintox Ammunition," <i>Journal of Forensic Sciences</i>, Vol. 39, No. 2, March 1994.</p> <p>17.12.11 Harris, A., "Analysis of Primer Residue from CCI Blazer Lead Free Ammunition by Scanning Electron Microscopy/Energy Dispersive X-Ray," <i>Journal of Forensic Sciences</i>, Vol. 40, No. 1, January 1995.</p> <p>17.12.12 Jalanti, T., Henchoz, P., Gallusser, A., Bonfanti, M. S. and Schwoeble, A. J. "The persistence of Gunshot Residue on Shooters' Hands," <i>Science & Justice</i>, Vol. 39, No. 1 1999.</p> <p>17.12.13 Kee, T. G. and C. Beck, "Casework Assessment of an Automated Scanning Electron Microscope/Microanalysis System for the Detection of Firearms Discharge Particles," <i>Journal of Forensic Science Society</i>, Vol. 27, 1987, pp. 321-330.</p>	

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<p>17.12.14 Kilty, J.W., "Activity after Shooting and its Effect on the Retention of Primer Residue," <i>Journal of Forensic Sciences</i>, Vol. 20, No. 2, 1975.</p> <p>17.12.15 Lebiedzik, Jozef and David Johnson, "Rapid Search and quantitative Analysis of Gunshot Residue Particles in SEM," <i>Journal of Forensic Sciences</i>, Vol. 45, No. 1, p. 83, 2000.</p> <p>17.12.16 Mann, M. and Espinoza, E. O., "The Incidence of Transient Particulate Gunshot Residue in Oregon and Washington Bow Hunters," <i>Journal of Forensic Sciences</i>, Vol. 38, No. 1, 1993.</p> <p>17.12.17 Meng, H. H., and Caddy, B., "Gunshot Residue Analysis – A Review", <i>Journal of Forensic Sciences</i>, Vol. 42, 1997, pp. 553-570.</p> <p>17.12.18 Midkiff, C. R., "The Changing Face of Firearms Residue Testing. Then and Now," Parts 1, 2, 3 and 4; MAAFS Newsletter, Vol. 25, No. 2, 3, and 4, 1997 and Vol. 28, No. 3, 2000.</p> <p>17.12.19 Mosher, P.V., et. al., "Gunshot Residue – Similar Particles Produced by Fireworks," <i>Can Soc. Forens. Sci. J.</i>, Vol. 31, No.2, 1998.</p> <p>17.12.20 Operators manual for Carbon evaporator.</p> <p>17.12.21 Reed, G. E., McGuire, P. J. and Boehm, A., "Analysis of Gunshot Residue Test Results in 112 Suicides," <i>Journal of Forensic Sciences</i>, Vol. 35, No. 1, 1990.</p> <p>17.12.22 Schwartz, Robert H. and Charles Zona, "A Recovery Method for Airborne Gunshot Residue Retained in Human Nasal Mucus," <i>Journal of Forensic Sciences</i>, Vol. 40, No. 4, 1995.</p> <p>17.12.23 Schwoeble, A. J. and Exline, D. <u>Current Methods in Forensic Gunshot Residue Analysis</u>, c. 2000.</p> <p>17.12.24 Singer, R. L., et. al., "A Survey of Gunshot Residue Analysis Methods," <i>Journal of Forensic Sciences</i>, Vol. 41, 1996, pp. 195-198.</p> <p>17.12.25 Stone, I. C. and Petty, C. S., "Examination of Gunshot Residues," <i>Journal of Forensic Sciences</i>, Vol. 19, No. 4, 1974.</p> <p>17.12.26 Wallace, J.S. "Discharge Residue Particles from Blank Cartridges," <i>AFTE Journal</i>, Vol 21, No. 2, April 1989.</p> <p>17.12.27 Wallace, J. S., "Chemical Aspects of Firearms Ammunition," <i>AFTE Journal</i>, Vol. 22, No. 4, October 1990.</p> <p>17.12.28 Wallace, J. S. and McQuillan, J. "Discharge Residues from Cartridge-operated Industrial Tools," <i>Journal of Forensic Science Society</i>, Vol. 24, 1984, pp 495-508.</p> <p>17.12.29 Wolten, G. M., et. al., "Particle Analysis for the Detection of Gunshot Residue II: Occupational and Environmental Particles," <i>Journal of Forensic Sciences</i>, 1979.</p> <p>17.12.30 Wrobel, Harald, et. al., "Comparison of Properties of Adhesive Tapes, Tabs, and Liquids Used for the Collection of Gunshot Residue and Other Trace Materials for SEM Analysis <i>Journal of Forensic Sciences</i>, Vol. 43, No. 1, 1998.</p> <p>17.12.31 Zeichner, A. and Levin, N., "Collection Efficiency of Gunshot Residue (GSR) Particles from Hair and Hands Using Double-Side Adhesive Tape," <i>Journal of Forensic Sciences</i>, Vol. 38, No. 3, 1993.</p> <p>17.12.32 Zeichner, A. and Levin, N., "More on the Uniqueness of Gunshot Residue (GSR) Particles," <i>Journal of Forensic Sciences</i>, Vol 42, No. 6, 1997.</p>	

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<p>17.12.33 Zeichner, Arie, et.al., “Antimony Enrichment on the Bullets’ Surfaces and the Possibility of Finding It in Gunshot Residue (GSR) of Ammunition Having Antimony-Free Primers,” <i>Journal of Forensic Science Society</i>, Vol. 43, No. 3, 1998.</p> <p>17.12.34 Zeichner, A., et. al., “Gunshot Residue Particles Formed by Using Ammunitions That Have Mercury Fulminate Based Primers,” <i>JFSCA</i>, Vol. 37, No. 4, Nov. 1992.</p> <p>17.12.35 Zeichner, A., et. al., “Gunshot Residue Particles Formed by Using Different Types of Ammunition in the Same Firearms,” <i>JFSCA</i>, Vol. 36, No. 4, July 1991.</p> <p>17.12.36 Zona, C. A., “The Analysis of Nyclad Ammunition Discharge Residues Using Transmission Electron Microscopy and Polarized Light Microscopy,” <i>Microscope</i>, Vol. 44:1, 1996, pp. 11-14.</p> <p align="right">◀End</p>	